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EXAMINER	
NOGUEROLA, ALEXANDER STEPHAN	

ART UNIT	PAPER NUMBER
1753	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	03/23/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/642,386	Applicant(s) WANG ET AL.	
	Examiner ALEX NOGUEROLA	Art Unit 1753	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on ____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-77* is/are pending in the application.

4a) Of the above claim(s) ____ is/are withdrawn from consideration.

5)☒ Claim(s) *27-29* is/are allowed.

6)☒ Claim(s) *1-26,30-74 and 77* is/are rejected.

7)☒ Claim(s) *75 and 76* is/are objected to.

8)☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *15 August 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *11/17/2003*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. ____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: ____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 1-25 and 38-72 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention:

a) Claim 1 recites the limitation "a second counter electrode" in line 5. There is insufficient antecedent basis for this limitation in the claim (there is no first counter electrode in the claim).

b) Claim 5: it is not clear to which electrode "the at least one electrolytic surface" is associated with as both the first working electrode and second counter electrode have at least one electrolytic surface.

c) Claim 16 recites the limitation "a second counter electrode" in line 6. There is insufficient antecedent basis for this limitation in the claim (there is no first counter electrode in the claim).

d) Claim 38 recites the limitation "the rotating disk electrode" in line 7. There is insufficient antecedent basis for this limitation in the claim.

e) Claim 57 recites the limitation "of the body" in line 7. There is insufficient antecedent basis for this limitation in the claim

3. Note that dependent claims will have the deficiencies of base and intervening claims.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 1-5, 14, and 15 are rejected under 35 U.S.C. 102(b) as being anticipated by Yabe et al. ("Rotating Ring Disk Electrode in Molten Chloride," *Electrochimica Acta*, Vol. 34, No. 10, pp. 1479-1483, 1989) ("Yabe").

Addressing claim 1, Yabe discloses an apparatus for evaluating an electrochemical reaction, the apparatus comprising

an electrochemical cell ("G" in Figure 1) comprising a cavity for containing a liquidus electrolyte (Represented by the horizontal line through the tips of the electrodes in Figure 2. See also the fourth sentence in Experimental on page 1479), a first working electrode ("A" in Figure 2) having at least one electrolytic surface at least partially within the cavity, and a second counter electrode ("B" in Figure 2) having at least one electrolytic surface at least partially within the cavity, the first working electrode comprising a body (unlabeled support rod for ring disk electrode shown in Figure 2) and an insert supported by the body (ring disk electrode A), each of the insert and the body consisting essentially of a high-temperature material allowing for preparation or processing of the at least one electrolytic surface at a temperature of at least 300°C (abstract - 723 K ≈ 450 ° C); and

a drive system (E) detachably coupled to the first working electrode or a portion thereof for effecting relative motion between the at least one electrolytic surface of the working electrode and a bulk portion of the liquidus electrolyte (Figures 1 and 2).

Addressing claim 2, for the additional limitation of this claim see the abstract and Figure 1.

Addressing claim 3, for the additional limitation of this claim see Figure 3.

Addressing claim 4, for the additional limitation of this claim see Figure 3 and note the electrically isolated ring electrode and disc electrode.

Addressing claim 5, Yabe does not disclose how the at least one electrolytic surface of either the first working electrode or the second counter electrode has been made. However, the additional limitation of claim 5 is a product-by-process limitation that, barring a showing of material difference in structure or composition from the electrolytic surface of the first working electrode of Yabe, is anticipated by Yabe since the first working electrode comprises a small, thin metal (Ni) electrodes (ring and disk) that are indistinguishable from electrodes made by physical vapor deposition.

Addressing claims 14 and 15, for the additional limitation of these claims see the first full paragraph under "Results and Discussion" on page 1480, which discloses that the disk electrode was polarized with a potential scan rate while the ring electrode as kept at a fixed potential. Also note Figure 4, which shows ring current and disk current plotted against disk potential.

6. Claims 1-3, 6, 11, and 12 are rejected under 35 U.S.C. 102(b) as being anticipated by Strycker et al. ("Development of a platinum rotating disc electrode for dynamic electrochemical measurements in glass melts," Journal of Non-Crystalline solids 289 (2001) 106-112) ("Strycker").

Addressing claim 1, Strycker discloses an apparatus for evaluating an electrochemical reaction, the apparatus comprising

an electrochemical cell (Figure 1) comprising a cavity (7) for containing a liquidus electrolyte (abstract – implied since electrochemical measurement are to be made on a glass melt), a first working electrode ("6" in Figure 1) having at least one electrolytic surface at least partially within the cavity (Figure 1), and a second counter electrode ("5" in Figure 1) having at least one electrolytic surface at least partially within the cavity, the first working electrode comprising a body and an insert supported by the body (Figure 1), each of the insert and the body consisting essentially of a high-temperature material allowing for preparation or processing of the at least one electrolytic surface at a temperature of at least 300°C (abstract - 1200 ° C); and

a drive system detachably coupled to the first working electrode or a portion thereof for effecting relative motion between the at least one electrolytic surface of the working electrode and a bulk portion of the liquidus electrolyte (10, 11, and last sentence in the first column on page 108).

Addressing claim 2, for the additional limitation of this claim see the abstract and Figure 1.

Addressing claim 3, for the additional limitation of this claim see the abstract and Figure 1.

Addressing claim 6, for the additional limitation of this claim see the first three sentences in the first full paragraph in the first column on page 107, which discloses that the rotating disc electrode may be made of metal or carbon.

Addressing claims 11 and 12, for the additional limitations of these claims note that Strycker discloses that using the apparatus at an operating temperature of 1200 °C. See the abstract and the second column on page 108.

7. Claims 16, 17, 21-24, 30, and 33 are rejected under 35 U.S.C. 102(e) as being anticipated by Al-Janabi et al. (US 6,621,263 B2) ("Al-Janabi").

Addressing claim 16, Al-Janabi discloses an apparatus for simultaneously evaluating multiple electrochemical reactions, the apparatus comprising:

a plurality of electrochemical cells (100-600, Figure 10), each of the plurality of electrochemical cells comprising a cavity (12) for containing a liquidus electrolyte, a first working electrode (58) having at least one electrolytic surface at least partially within the cavity (Figure 1), and a second counter electrode (26) having at least one electrolytic surface at least partially within the cavity (Figure 1); and

a drive system (78, 80) coupled to the first working electrode or a portion thereof of each of the plurality of electrochemical cells for simultaneously effecting relative motion between the at least one electrolytic surface of each working electrode and a bulk portion of its respective liquidus electrolyte (Figure 10 and col. 06:05-06).

Addressing claim 17, Al-Janabi only mentions using an electrolytic surface with the same composition as compared between each of the plurality of electrochemical cells, although different test conditions, such as different corrosive gases may be used as compared between each of the plurality of electrochemical cells. See col. 06:05-18. It would have been obvious to one with ordinary skill in the art at the time of the invention to have at least one electrolytic surface be defined by different materials as

compared between each of the plurality of electrochemical cells and the test conditions the same as compared between each of the plurality of electrochemical cells because then different materials can be compared to see which is the most resistant to a particular corrosive substance.

Addressing claim 21, for the additional limitation of this claim see col. 05:57-65, which discloses x-y-**z** positioning components extending from a mount plate for the cell.

Addressing claim 22, for the additional limitation of this claim see the abstract and col. 05:34-49.

Addressing claims 23 and 24, for the additional limitations of these claims see col. 06:10-39 and col. 06:56-67.

Addressing claim 30, Al-Janabi discloses an electrochemical apparatus for screening a material, the apparatus comprising

a plurality of electrochemical cells (100, 200, 300, ..., 600), each of the plurality of electrochemical cells comprising a cavity (12) for containing liquidus electrolyte (col. 06:10-22); and

a plurality of electrodes (58 or 30) comprising at least one electrolytic surface for positioning at least partially within the cavity (Figure 1);

wherein each of the plurality of electrochemical cells is movable independent from the other cells to vary an insertion depth of the electrode within the cavity (implied by col. 05:57-65, which discloses x-y-**z** positioning components extending from a mount plate for the cell).

Addressing claim 33, for the additional limitation of this claim see col. 05:34-49.

8. Claims 16-19 and 22-24 are rejected under 35 U.S.C. 102(e) as being anticipated by Landau (US 6,884,333 B2) ("Landau"). Landau is a CIP of application No. 10/267,505, filed on October 9, 2002, which is before Applicant's filing date (and priority date) of August 15, 2003. The disclosure of Landau and application No. 10/267,505 appear to be the same except for additional drawings Figures 9A-F, which are in Landau, but not in application No. 10/267,505 and are not relied on for these rejections.

Addressing claim 16, Landau discloses an apparatus for simultaneously evaluating multiple electrochemical reactions, the apparatus comprising:

a plurality of electrochemical cells (10, Figure 3G), each of the plurality of electrochemical cells comprising a cavity (10) for containing a liquidus electrolyte, a first working electrode (60) having at least one electrolytic surface at least partially within the cavity, and a second counter electrode (62) having at least one electrolytic surface at least partially within the cavity (col. 10:49-52 and col. 13:19-41); and

a drive system coupled to the first working electrode or a portion thereof of each of the plurality of electrochemical cells for simultaneously effecting relative motion between the at least one electrolytic surface of each working electrode and a bulk portion of its respective liquidus electrolyte (implied by Figure 5B, which has an arrow signifying rotation of the shaft of the rotating segmented disk electrode 60).

Addressing claim 17, Landau only discloses using an electrolytic surface with the same composition as compared between each of the plurality of electrochemical cells, although different test conditions, such as different pH, additives, and contaminants may be used as compared between each of the plurality of electrochemical cells. See the abstract. It would have been obvious to one with ordinary skill in the art at the time of the invention to have at least one electrolytic surface be defined by different materials as compared between each of the plurality of electrochemical cells and the test conditions the same as compared between each of the plurality of electrochemical cells

because then different materials can be compared to see which is the most resistant to a particular corrosive substance.

Addressing claim 18, for the additional limitation of this claim note segmented ring electrode 60 in insulating ring 64 in Figure 5B.

Addressing claim 19, for the additional limitation of this claim see Figure 5B.

Addressing claim 22, for the additional limitation of this claim see col. 13:19-41.

Addressing claims 23 and 24, for the additional limitations of these claims see col. 11:52 – col. 12:03 and col. 12:28 – col. 13:41.

9. Claims 34-36 are rejected under 35 U.S.C. 102(b) as being anticipated by Kunimatsu et al. (US 6,106,692) ("Kunimatsu").

Addressing claim 34, Kunimatsu discloses a method for parallel electrochemical screening of materials, the method comprising

providing an electrochemical cell comprising a cavity (11) for containing a liquidus electrolyte (Figure 14);

inserting a plurality of working electrodes (131,132) within the cavity (Figure 14), each of the working electrodes having at least one electrolytic surface formed on or integral with at least a portion thereof and inserted into the cavity for exposure to the liquidus electrolyte (Figure 14);

inserting a plurality of counter electrodes (141, 142 (note that although 142 is identified as a reference electrode in col. 12, 07-24, it is clear from the context and Figure 14 that it is a counter electrode as electrodes 142, 132, and 152 are of the same type respectively as electrodes 141, 131, and 151, respectively);

inserting at least one reference electrode (151) into the liquidus electrolyte (Figure 14); and

performing electrochemical testing to screen the at least one electrolytic surface of each of the working electrodes (col. 11:56 – col. 13:44).

Addressing claim 35, for the additional limitation of this claim see col. 16:10-47, which discloses forming the electrolytic surface using microwaves to cause plasma discharge and thus a high temperature process.

Addressing claim 36, for the additional limitation of this claim see col. 05:55-58 and col. 14:41-51.

10. Claims 34 and 35 are rejected under 35 U.S.C. 102(b) as being anticipated by Jasinski et al. (US 4,863,572) ("Jasinski").

Addressing claim 34, Jasinski discloses a method for parallel electrochemical screening of materials, the method comprising

providing an electrochemical cell comprising a cavity (14) for containing a liquidus electrolyte (Figure 1 and col. 09:01-13);

inserting a plurality of working electrodes (16 in Figures 2 and 29) within the cavity (Figure 1), each of the working electrodes having at least one electrolytic surface formed on or integral with at least a portion thereof and inserted into the cavity for exposure to the liquidus electrolyte (Figures 1, 3, 28, and 29);

inserting a plurality of counter electrodes (20) into the cavity (Figures 1, 3, 28, and 29);

inserting at least one reference electrode (18) into the liquidus electrolyte (Figures 1, 3, 28, and 29); and

performing electrochemical testing to screen the at least one electrolytic surface of each of the working electrodes (col. 21:50 – col. 22:23; col. 42:55 – col. 43:11; and col. 62:28-62).

Addressing claim 35, Jasinski does not disclose how the electrolytic surface on any of the electrodes is formed; however, whether a high temperature process was used or not is just a product-by-process limitation that does not, barring more, structurally or compositionally distinguish Applicant's electrolytic surfaces from those in

Jasinski, especially since the electrodes in Jasinski are thin films (Figures 2 and 28) that could have been made with a high temperature process.

11. Claims 38, 41, 43-45, 54, 56, 64-67, 73, 74, and 77 are rejected under 35 U.S.C. 102(b) as being anticipated by Stojanovic et al. ("Development of a rotating ring-disc electrode for high temperature studies in cryolite-based melts," journal of Applied Electrochemistry 25 91995) 456-461) ("Stojanovic").

Addressing claim 38, Stojanovic discloses a method of making a working electrode, the method comprising:

providing a body ("(f) gold tube" – Figure 1);

applying an external coating to the body to create an external sleeve (sleeve "(i) outer boron nitride insulating sheath", which is applied over the body – see Figure 1 and lines 14-18 in the second column on page 457. Note that "coating" is defined in Webster's dictionary as "a layer of any substance used as a cover, protection, decoration, or finish."); and

inserting an insert formed from an electrode material ("(h) molybdenum rod") into an opening in one end of the body (Figure 1 and lines 20-23 in the first column on page 457);

wherein the material of the body and the material of the insert allow for preparation or processing of the rotating disk electrode at temperatures greater than 300 °C (implied since the electrode can be used temperatures up to 1000 °C – abstract).

Addressing claim 41, for the additional limitation of this claim see the second column on page 457, which states, "The electrode face was machined flush removing the slotted end-piece, ensuring that the ring and disc were coplanar, and *finished with grade P800 emery paper using alcohol as the lubricant.* [emphasis added]"

Addressing claims 43 and 44, for the additional limitations of these claims note that the external sleeve is "(i) outer boron nitride insulating sheath" in Figure 1.

Addressing claim 45, for the additional limitation of this claim see the first two paragraphs in *2.2 Electrochemical instrumentation and laboratory cell* on page 257.

Addressing claim 54, for the additional limitation of this claim see the abstract, which discloses operating temperatures up to 1000 °C.

Addressing claims 56 and 64, for the additional limitation of this claim see the first column on page 457, which discloses that the entire electrode assembly is screwed on the Inconel shaft/ rotator connection.

Addressing claim 57, Stojanovic discloses a rotating disk electrode comprising:

an insert formed from an electrode material ("(h) molybdenum rod") (Figure 1);

a tubular member ("(f) gold tube" – Figure 1) having an opening formed at one end thereof for receiving the insert (see Figure 1 and lines 20-23 in the first column on page 457, which discloses inserting the insert into the tubular member); and

a coating applied to an external surface of the tubular member to form an electrical insulating sleeve (sleeve "(i) outer boron nitride insulating sheath", which is applied over the body – see Figure 1 and lines 14-18 in the second column on page 457. Note that "coating" is defined in Webster's dictionary as "a layer of any substance used as a cover, protection, decoration, or finish.");

wherein the material of the body and the material of the insert allow for processing or preparation of the rotating disk electrode at temperatures greater than 300 °C (implied since the electrode can be used temperatures up to

1000 °C – abstract).

Addressing claim 65, for the additional limitation of this claim see Figure 1 which shows the outer Inconel tube (c) "slipped fitted" into the outer boron nitride insulating sheath.

Addressing claim 66, for the additional limitation of this claim see the second paragraph in the first column on page 457, bridging to the second column, which discloses two separate electrical contacts between the drive shaft and the rotating disk electrode: "The entire assembly [rotating disk electrode] was then screwed onto an Inconel 600 shaft ..., the end of which had been machined to suit the electrode rotator; this provided the electrical contact to the molybdenum disc" and "Two small stainless steel screws were inserted directly through the outer Inconel tube and boron nitride support into the gold tube to provide electrical contact to the gold ring."

Addressing claim 67, for the additional limitation of this claim consider the first paragraph of *3.2 Rotating ring-disc voltammetry in cryolite-based melts*, which discloses "scanning the disk potential while maintaining the ring potential at 1.0V" to provide a disc current – disc potential curve. Thus, one contact point is capable of carrying current and the other contact point is capable of being used for voltage sensing.

Addressing claim 68, for the additional limitation of this claim see Figure 1 and the first column on page 457, which states, "The rod was then threaded at the smaller diameter end and inserted into the boron nitride-sleeved gold tube to form a liquid-tight seal."

Addressing claim 73, Stojanovic discloses a rotating disk electrode comprising:

a body ("(i) outer boron nitride insulating sheath" – figure 1) formed from an electrical insulating material;

an insert ("(h) molybdenum rod") supported by the body and comprising an electrolytic surface being formed on or integral with the insert (Figure 1);

wherein the material of the body and the material of the insert allow for processing or preparation of the rotating disk electrode at temperatures greater than 300 °C (implied since the electrode can be used temperatures up to 1000 °C – abstract).

Addressing claim 74, for the additional limitation of this claim see the first paragraph in the first column on page 457.

Addressing claim 77, for the additional limitation of this claim see the abstract, which discloses operating temperatures up to 1000 °C.

Claim Rejections - 35 USC § 103

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

13. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

14. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was

not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

15. Claims 20 and 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Landau (US 6,884,333 B2) ("Landau") in view of Stojanovic et al. ("Development of a rotating ring-disc electrode for high temperature studies in cryolite-based melts," journal of Applied Electrochemistry 25 91995) 456-461) ("Stojanovic") and Ito et al. ('Rotating Ring Disk Electrode in Molten Chloride Systems," Materials Science Forum vol. 73 – 75 (1991) pp. 409-414) ("Ito"). Landau is a CIP of application No. 10/267,505, filed on October 9, 2002, which is before Applicant's filing date (and priority date) of August 15, 2003. The disclosure of Landau and application No. 10/267,505 appear to be the same except for additional drawings Figures 9A-F, which are in Landau, but not in application No. 10/267,505 and are not relied on for these rejections.

Addressing claims 20 and 25, Landau discloses an apparatus for simultaneously evaluating multiple electrochemical reactions, the apparatus comprising:

a plurality of electrochemical cells (10, Figure 3G), each of the plurality of electrochemical cells comprising a cavity (10) for containing a liquidus electrolyte, a first working electrode (60) having at least one electrolytic surface at least partially within the cavity, and a second counter electrode (62) having at least one electrolytic surface at least partially within the cavity (col. 10:49-52 and col. 13:19-41); and

a drive system coupled to the first working electrode or a portion thereof of each of the plurality of electrochemical cells for simultaneously effecting relative motion between the at least one electrolytic surface of each working electrode and a bulk portion of its respective liquidus electrolyte (implied by Figure 5B, which has an arrow signifying rotation of the shaft of the rotating segmented disk electrode 60).

Landau also discloses having the working electrode comprise an electrically insulating body (64) and an electrically conductive insert (60) supported by the body (Figure 5B).

Landau further discloses that the electrolyte temperature is an important factor in electrochemical measurements and provides means for temperature control. See col. 03:65 – col. 04:46 (especially col. 04:16); col. 05:07-11; and col. 19:25-42. However, Landau does not mention having the insert comprise a high-temperature material allowing for preparation or processing of the at least one electrolytic surface at a temperature of at least 300 °C or having the first working electrode be formed at least partially from a high-temperature material allowing for testing at a temperature of at least 80 °C.

Stojanovic and Ito each disclose a rotating ring disk electrode for high temperature systems. The rotating ring disk electrode comprises an electrically insulating body and an electrically conductive insert supported by the body with the insert comprising a high-temperature material allowing for preparation or processing of the at least one electrolytic surface at a temperature of at least 300 °C. See the abstracts and Figure 1 of each article. It would have been obvious to one with ordinary

skill in the art at the time of the invention to use a rotating ring disk electrode as taught by Stojanovic or Ito in the invention of Landau because this will optimize measurements in cryolite-based melts and in molten chloride systems, respectively. See the abstracts and conclusions of the articles. Moreover, some conventional working electrodes may be severely damaged at a temperature of at least 300 °C.

16. Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Satsuni et al. (US 6,251,245) ("Satsuni").

Satsuni discloses an electrochemical apparatus for screening a material, the apparatus comprising

an electrochemical cell (1) comprising a cavity (C) for containing liquidus electrolyte (abstract); and

an electrode (5) comprising at least one electrolytic surface for positioning at least partially within the cavity (Figure 1);

wherein the electrochemical cell is independently movable independent to vary an insertion depth of the electrode within the cavity (Figure 1 and col. 04:21-27).

Satsuni does not mention providing a plurality of electrochemical cells; however, barring evidence to the contrary, such as unexpected result, this is just mere multiplication of parts for a multiplied effect. It would have been obvious to one with ordinary skill in the art at the time of the invention to provide a plurality of electrochemical cells because then many different samples could be measured at the

same time or different measurements could be made simultaneously on a number of samples form the same source.

17. Claim 31 is rejected under 35 U.S.C. 103(a) as being unpatentable over Satsuni et al. (US 6,251,245) as applied to claim 30 above, and further in view of Cammann (US 5,445,726) or Trampert (US 4,166,020).

Satsuni does not mention whether the electrode comprises a body and an insert supported by the body, and at least one electrolytic surface being formed on or integral with the insert.

Cammann and Trampert each disclose an electrode comprising a body and an insert supported by the body, and at least one electrolytic surface being formed on or integral with the insert. See Figure 2 in Cammann and the figure in Trampert. It would have been obvious to one with ordinary skill in the art at the time of the invention to use an electrode having a body and insert as taught by Cammann or Trampert in the invention of Satsuni because as taught by Cammann their electrode will prevent or drastically reduce bleeding of selectively-generating membrane components and also prevent or drastically reduce impairment of the ratio of the standard exchange current density of measured ions to interfering ions, and as taught by Trampert their electrode design offers increase mechanical stability and the reference electrets may be exchanged without difficulties. See in Cammann col. 02:62 – col. 03:07 and in Trampert col. 02:65 – col. 03:05.

18. Claims 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Satsuni et al. (US 6,251,245) as applied to claim 30 above, and further in view of Ramaswami et al. ("Rotating Disk studies in Molten Carbonates I. Electrode Design," J. Electrochem. Soc., Vol. 141, No. 3, March 1994) ("Ramaswami").

Addressing claim 31, Satsuni does not mention whether the electrode comprises a body and an insert supported by the body, and at least one electrolytic surface being formed on or integral with the insert.

Ramaswami discloses an electrode comprising a body and an insert supported by the body, and at least one electrolytic surface being formed on or integral with the insert. See Figures 1 and 2. It would have been obvious to one with ordinary skill in the art at the time of the invention to use an electrode as taught by Ramaswami in the electrochemical apparatus of Satsuni because "[s]uch an electrode design can facilitate convective mass-transfer studies at high temperatures which hitherto have been largely confined to aqueous media and low temperature molten salts." See the **Conclusion**.

Addressing claim 32, for the additional limitation of this claim see the first sentence of the **Conclusion**.

19. Claims 31-33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Al-Janabi (US 6,621,263 B2) in view of Ramaswami et al. ("Rotating Disk studies in Molten Carbonates I. Electrode Design," J. Electrochem. Soc., Vol. 141, No. 3, March 1994) ("Ramaswami").

Addressing claims 31 and 32, Al-Janabi discloses an electrochemical apparatus for screening a material, the apparatus comprising

a plurality of electrochemical cells (100, 200, 300, ..., 600), each of the plurality of electrochemical cells comprising a cavity (12) for containing liquidus electrolyte (col. 06:10-22); and

a plurality of electrodes (58 or 30) comprising at least one electrolytic surface for positioning at least partially within the cavity (Figure 1);

wherein each of the plurality of electrochemical cells is movable independent from the other cells to vary an insertion depth of the electrode within the cavity (implied by col. 05:57-65, which discloses x-y-**z** positioning components extending from a mount plate for the cell).

Al-Janabi does not mention whether the electrode comprises a body and an insert supported by the body, and at least one electrolytic surface being formed on or integral with the insert.

Ramaswami discloses an electrode comprising a body and an insert supported by the body, and at least one electrolytic surface being formed on or integral with the

insert. See Figures 1 and 2. It would have been obvious to one with ordinary skill in the art at the time of the invention to use an electrode as taught by Ramaswami in the electrochemical apparatus of Al-Janabi because "[s]uch an electrode design can facilitate convective mass-transfer studies at high temperatures which hitherto have been largely confined to aqueous media and low temperature molten salts." See the **Conclusion**.

Addressing claim 33, for the additional limitation of this claim see in Al-Janabi col. 05:34-49 and Ramaswami the abstract.

20. Claim 37 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kunimatsu et al. (US 6,106,692) ("Kunimatsu") over the Derwent abstract of Kunimatsu et al. (US 6,106,692).

Addressing claim 37, Kunimatsu discloses a method for parallel electrochemical screening of materials, the method comprising

providing an electrochemical cell comprising a cavity (11) for containing a liquidus electrolyte (Figure 14);

inserting a plurality of working electrodes (131,132) within the cavity (Figure 14), each of the working electrodes having at least one electrolytic surface formed on or

integral with at least a portion thereof and inserted into the cavity for exposure to the liquidus electrolyte (Figure 14);

inserting a plurality of counter electrodes (141, 142 (note that although 142 is identified as a reference electrode in col. 12, 07-24, it is clear from the context and Figure 14 that it is a counter electrode as electrodes 142, 132, and 152 are of the same type respectively as electrodes 141, 131, and 151, respectively);

inserting at least one reference electrode (151) into the liquidus electrolyte (Figure 14); and

performing electrochemical testing to screen the at least one electrolytic surface of each of the working electrodes (col. 11:56 – col. 13:44).

Kunimatsu does not mention performing tests at a temperature greater than 80°C. However, it would have been obvious to one with ordinary skill in the art at the time of the invention to do so because the Derwent abstract of Kunimatsu et al. states that the measuring sensor "[s]uits high temperature – high pressure service in corrosion prone areas."

21. Claims 69 and 70 are rejected under 35 U.S.C. 103(a) as being unpatentable over Stojanovic et al. ("Development of a rotating ring-disc electrode for high temperature studies in cryolite-based melts," journal of Applied Electrochemistry 25 91995) 456-461) ("Stojanovic").

Addressing claims 69 and 70, Stojanovic discloses a rotating disk electrode

comprising:

an insert formed from an electrode material ("(h) molybdenum rod") (Figure 1);

a tubular member ("(f) gold tube" – Figure 1) having an opening formed at one end thereof for receiving the insert (see Figure 1 and lines 20-23 in the first column on page 457, which discloses inserting the insert into the tubular member); and

a coating applied to an external surface of the tubular member to form an electrical insulating sleeve (sleeve "(i) outer boron nitride insulating sheath", which is applied over the body – see Figure 1 and lines 14-18 in the second column on page 457. Note that "coating" is defined in Webster's dictionary as "a layer of any substance used as a cover, protection, decoration, or finish.");

wherein the material of the body and the material of the insert allow for processing or preparation of the rotating disk electrode at temperatures greater than 300 °C (implied since the electrode can be used temperatures up to 1000 °C – abstract).

In Stojanovic the thickness of the sleeve is 3 mm (16 mm i.d. x 19 mm o.d. – second column on page 457); however, barring evidence to the contrary, such as unexpected results, to make the sleeve thinner, particularly within the claimed thickness ranges, is just a matter of scaling down the size of the rotating disk electrode. It would be useful to do so because there may only be a very small amount of sample available or only a small of amount of space is available to access the melt.

Allowable Subject Matter

22. Claims 26-29 are allowed.

23. Claims 75 and 76 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

24. Claims 7-10, 13, 39, 40, 42, 46-53, 55, 58-63, 71, and 72 would be allowable if rewritten to overcome the rejections under 35 U.S.C. 112, 2nd paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

25. The following is a statement of reasons for the indication of allowable subject matter:

a) Claim 7: the combination of limitations requires the body to be formed from graphite. In Yabe and Strycker the body is formed from alumina. See in Yabe the figure 3 caption and the first column on page 1480 and in Strycker the second column on page 107 ("the working disc electrode is a platinum rod ... fixed in an alumina tube ...").

b) Claim 8 depends from allowable claim 7.

c) Claim 9: the combination of limitations requires the body to be formed from aluminium and the body to comprise an external anodize coating. In Yabe and Strycker the body is formed from alumina. See in Yabe the figure 3 caption and the first column on page 1480 and in Strycker the second column on page 107 ("the working disc electrode is a platinum rod ... fixed in an alumina tube ...").

d) Claim 10: the combination of limitations requires the body to be formed from steel and the body to comprise an external anodize coating. In Yabe and Strycker the body is formed from alumina. See in Yabe the figure 3 caption and the first column on page 1480 and in Strycker the second column on page 107 ("the working disc electrode is a platinum rod ... fixed in an alumina tube ...").

e) Claim 13: the combination of limitations requires the high-temperature material to allow for preparation or processing of the at least one electrolytic surface at a temperature of at least 2000 °C. Strycker only discloses an upper operating temperature of 1200 °C and does suggest using the apparatus at higher temperatures.

f) Claim 21: the combination of limitations requires each of the plurality of electrochemical cells to be "movable independent from the other cells to vary an insertion depth of the at least one electrolytic surface relative to a depth of the liquidus electrolyte." In Al-Janabi et al. the

g) Claim 26: the combination of limitations requires "a drive system coupled to the first working electrodes or a portion thereof for effecting relative motion between the at least one electrolytic surface of the working electrode and a bulk portion of the liquidus electrolyte."

In Almon (US 5,217,112) the working electrodes are preferably separated from each other by the same distance and are shown to be held at the depth within the liquidus electrolyte. See col. 01:64 – col. 02:01; col. 02:56-57 and Figure 2.

In Yamamoto et al. (US 4,172,777) "[a]ll [of the electrodes] are fixed at a pre-determined position and height by a suitable means, and at the position shown in **FIG.1.**" See col. 02:12-17. Relative motion between at least one electrolytic surface of the working electrode and a bulk portion of the liquidus electrolyte is caused by cavity (1). See col. 02:35-43 and Figure 1.

In Warren et al. (US 6,187,164 B1) the working electrodes (part of assembly 86) are held in a fixed position when placed into the cavity. See Figure 4A.

h) Claims 27-29 depend directly or indirectly from allowable claim 26.

i) Claim 39: the combination of limitations requires the step of "applying a physical vapor deposition coating to an exposed end of the insert to form an electrolytic surface."

In Stojanovic "[t]he electrode face was machined flush removing the slotted end-piece, ensuring that the ring and disc were coplanar, and finished with grade P800 emery paper using alcohol as the lubricant." See the second column on page 457.

In Behl et al. (US 4,696,103) the insert (3) is not inserted into an opening in one end of the body, but instead inserted through the external sleeve (2) and screwed onto a screw (4) attached to an end of the body. See col. 02:37-60.

Also, the insert does not allow for preparation or processing of the rotating disk electrode at temperatures greater than 300 °C because it is made of lithium or sodium (abstract and claim 2), which has a melting point of 180.54 °C and 97.8 °C, respectively.

i) Claim 40: the combination of limitations requires the step of "electroplating an exposed end of the insert to form an electrolytic surface."

In Stojanovic "[t]he electrode face was machined flush removing the slotted end-piece, ensuring that the ring and disc were coplanar, and finished with grade P800 emery paper using alcohol as the lubricant." See the second column on page 457.

In Behl et al. (US 4,696,103) the insert (3) is not inserted into an opening in one end of the body, but instead inserted through the external sleeve (2) and screwed onto a screw (4) attached to an end of the body. See col. 02:37-60.

Also, the insert does not allow for preparation or processing of the rotating disk electrode at temperatures greater than 300 °C because it is made of lithium or sodium (abstract and claim 2), which has a melting point of 180.54 °C and 97.8 °C, respectively.

i) Claim 42: the combination of limitations requires the step of "modifying an exposed end of the insert with powder impregnation."

In Stojanovic "[t]he electrode face was machined flush removing the slotted end-piece, ensuring that the ring and disc were coplanar, and finished with grade P800 emery paper using alcohol as the lubricant." See the second column on page 457.

In Behl et al. (US 4,696,103) the insert (3) is not inserted into an opening in one end of the body, but instead inserted through the external sleeve (2) and screwed onto a screw (4) attached to an end of the body. See col. 02:37-60. Also, the insert does not allow for preparation or processing of the rotating disk electrode at temperatures greater than 300 °C because it is made of lithium or sodium (abstract and claim 2), which has a melting point of 180.54 °C and 97.8 °C, respectively.

j) Claim 46: the combination of limitations requires the step of applying an external coating to comprise subjecting the body to chemical vapor deposition.

In Stojanovic the external coating is screwed over the ring assembly. See lines 14-18 in the second column on page 457.

k) Claim 47: the combination of limitations requires the step of applying an external coating to comprise growing a boron nitride layer to form the external sleeve.

Although the external sleeve in Stojanovic is made of boron nitride it is not grown over the body, but premade and screwed over the ring-disc assembly. See lines 14-18 in the second column on page 457.

l) Claim 48: the combination of limitations requires the body to be formed from graphite. In Stojanovic the body is made of gold ("(f) gold tube" – Figure 1).

m) Claim 49: the combination of limitations requires the insert to be formed from carbon. In Stojanovic the body is made of molybdenum ("(h) molybdenum rod").

n) Claim 50: the combination of limitations requires the step of applying an external coating to comprise anodizing external surfaces of the body.

In Stojanovic the external coating is a premade boron nitride sheath that is screwed over the ring-disc assembly. See lines 14-18 in the second column on page 457.

o) Claim 51: the combination of limitations requires the body to be formed from aluminum. In Stojanovic the body is made of gold ("(f) gold tube" – Figure 1).

p) Claim 52: the combination of limitations requires the body to be formed from steel. In Stojanovic the body is made of gold ("(f) gold tube" – Figure 1).

q) Claim 53: the combination of limitations requires the step of applying an external coating to comprise applying Silcosteel®.

In Stojanovic the external coating is a premade boron nitride sheath that is screwed over the ring-disc assembly. See lines 14-18 in the second column on page 457.

r) Claim 55: the combination of limitations requires the materials of the body and insert to allow for processing or preparation of the rotating disk electrode at a temperature of at least 2000 °C.

In Stojanovic the insert is made of molybdenum, which has a melting point of 2617.0 °C (Chemical Elements.com – Molybdenum); however, the body is made from gold, which has a melting point of 1064.43 °C (Chemical Elements – Gold) and thus would not allow processing or preparation of the rotating disk electrode at a temperature of at least 2000 °C.

s) Claim 58: the combination of limitations requires "a physical vapor deposition coating applied to an exposed end of the insert to form an electrolytic surface."

In Stojanovic "[t]he electrode face was machined flush removing the slotted end-piece, ensuring that the ring and disc were coplanar, and finished with grade P800 emery paper using alcohol as the lubricant." See the second column on page 457.

In Behl et al. (US 4,696,103) the insert (3) is not inserted into an opening in one end of the body, but instead inserted through the external sleeve (2) and screwed onto a screw (4) attached to an end of the body. See col. 02:37-60. Also, the insert does not allow for preparation or processing of the rotating disk electrode at temperatures greater than 300 °C because it is made of lithium or sodium (abstract and claim 2), which has a melting point of 180.54 °C and 97.8 °C, respectively.

t) Claim 59 depends from allowable claim 58.

u) Claim 60: the combination of limitations requires the coating applied to the external surface of the tubular member to comprise an anodize coating.

In Stojanovic the external coating is a premade boron nitride sheath that is screwed over the ring-disc assembly. See lines 14-18 in the second column on page 457.

v) Claim 61: the combination of limitations requires the tubular member to be formed from aluminum. In Stojanovic the body is made of gold ("(f) gold tube" – Figure 1).

w) Claim 62: the combination of limitations requires the tubular member to be formed from steel. In Stojanovic the body is made of gold ("(f) gold tube" – Figure 1).

x) Claim 63: the combination of limitations requires the materials of the tubular member and insert to allow for processing of the rotating disk electrode at a temperature of at least 2000 °C.

In Stojanovic the insert is made of molybdenum, which has a melting point of 2617.0 °C (Chemical Elements.com – Molybdenum); however, the body is made from gold, which has a melting point of 1064.43 °C (Chemical Elements – Gold) and thus would not allow processing of the rotating disk electrode at a temperature of at least 2000 °C.

y) Claim 71: the combination of limitations requires the thermal expansion coefficient of the tubular member to be about ten times greater than the thermal expansion coefficient of the insert.

In Stojanovic the tubular member is made of gold, which has a thermal coefficient of expansion of 1.4 x 10 $^{-5}$ in./ (in. °C) (see "Chart of COE's Coefficient of Thermal Expansion" from www.lucasmilpaupt.com), and the insert is made of molybdenum, which has a thermal coefficient of expansion of between 0.5 to 0.6 x 10 $^{-5}$ in./ (in. °C). Thus, the thermal expansion coefficient of the tubular member is less than three times greater than the thermal expansion coefficient of the insert.

z) Claim 72: the combination of limitations requires the thermal expansion coefficient of the tubular member to be generally the same as the thermal expansion coefficient of the insert.

In Stojanovic the tubular member is made of gold, which has a thermal coefficient of expansion of 1.4 x 10 $^{-5}$ in./ (in. °C) (see "Chart of COE's Coefficient of Thermal Expansion" from www.lucasmilpaupt.com), and the insert is made of molybdenum, which has a thermal coefficient of expansion of between 0.5 to 0.6 x 10 $^{-5}$ in./ (in. °C). Thus, the thermal expansion coefficient of the tubular member is between two and three times greater than the thermal expansion coefficient of the insert.

A1) Claim 75: the combination of limitations requires the body to be formed from sapphire. In Stojanovic the body is made of boron nitride.

A2) Claim 76: the combination of limitations requires the insert to be formed from glassy carbon. In Stojanovic the insert is made of molybdenum.

26. Any inquiry concerning this communication or earlier communications from the examiner should be directed to ALEX NOGUEROLA whose telephone number is (571) 272-1343. The examiner can normally be reached on M-F 8:30 - 5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, NAM NGUYEN can be reached on (571) 272-1342. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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